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EXAMINER	
ABRAHAM, SALIEU M	
ART UNIT	**PAPER NUMBER**
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SHORTENED STATUTORY PERIOD OF RESPONSE	MAIL DATE	DELIVERY MODE
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Please find below and/or attached an Office communication concerning this application or proceeding.

If NO period for reply is specified above, the maximum statutory period will apply and will expire 6 MONTHS from the mailing date of this communication.

Office Action Summary	**Application No.** 10/605,645	**Applicant(s)** SARANATHAN ET AL.	
	Examiner Salieu M. Abraham	**Art Unit** 3709	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on 27 February 2004.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) 1-25 is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) 1-25 is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☒ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on 15 October 2003 is/are: a)☐ accepted or b)☒ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date 10/15/03 & 2/27/04.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

5) ☐ Notice of Informal Patent Application

6) ☐ Other: _____.

DETAILED ACTION

Drawings

1. The drawings are objected to as failing to comply with 37 CFR 1.84(p)(5) because the following reference sign(s) mentioned in the specification in Section [0029], page 15 with respect to figure 2 and, Section [0030], page 16 with respect to figure 3 are inconsistent with the specification:

With Respect to Figure 2

a. k_{sil}, k_r, K_{siM-1} and K_{siM}

With Respect to Figure 3

a. 0.15 k_{rmax}, 0.4 k_{rmax} and 1.0k_{rmax}

Corrected drawing sheets in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. Each drawing sheet submitted after the filing date of an application must be labeled in the top margin as either "Replacement Sheet" or "New Sheet" pursuant to 37 CFR 1.121(d). If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

Specification

2. The disclosure is objected to because of the following informalities: reference to "the computer is further caused to play out a magnetic preparation pulse at a ***different for each partition***, the rate being dependent on the given distance a partition is from the center of k-space", is unclear (see section [0036], page 20 of specification). It appears the word "rate" should be inserted between "different" and "for". Appropriate correction is required.

Claim Objections

3. Claims 18, 23 and 24 are objected to because of the following informalities:

a. Claim 18 is objected to as lacking antecedent basis in the specification with reference to " at least one of a heart... region."

b. The word "xtent" is misspelled in claim 23

c. "kd-space iscontinuity" and kv-space iews " contain typographical errors in claim 24.

Appropriate correction is required.

Claim Rejections - 35 USC § 112

3. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

4. Claims 12 -19 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

In Reference to Claims 12, 15-19

The claims recite the following limitation in line 1: "The MRI apparatus of claim 10". There is no antecedent basis for the preamble in claims 1 and 10. Claims 1 and 10 are method claims and claims 12 and 15-19 are inconsistent. It appears that these claims should depend from claim 11.

In Reference to Claim 13

The step "wherein the first rate is less than the second rate if the first radial partition is closer to the center of k-space than the second radial partition" is contradictory with the disclosure and therefore unclear. All other references in the disclosure to magnetization pulse rates being applied in a first, closer to k-space center region, were described as being higher than rates applied in peripheral regions farther from k-space center. Appropriate correction is required in order to particularly and distinctly point out what the invention encompasses.

Claim Rejections - 35 USC § 101

5. 35 U.S.C. 101 reads as follows:

> Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title.

6. Claims 20-25 are rejected under 35 U.S.C. 101 because the claimed invention is directed to non-statutory subject matter (see sections relating to functional and nonfunctional descriptive material in MPEP 2106 <2106.01> and the "Interim Guidelines for Examination of Patent Applications for Patent Subject Matter Eligibility <signed 26 Oct 2005">).

In Reference to Claims 20-24

The computer program referred to in the claims lacks storage on a medium that enables underlying functionality to occur. Furthermore, while the disclosure describes a computer readable storage medium on which the computer program of the invention is stored, this language is missing from the claims (unclaimed), and, moreover, is non-statutory because it (the storage medium) encompasses non-statutory matter vis-à-vis a "computer data signal embodied in a carrier wave."

In Reference to Claim 25

The claim explicitly cites "the computer program of claim 20 incorporated into a computer data signal that is embodied in a carrier wave that is uploadable/downloadable to an MR apparatus". The claim neither overcomes the original claim 20 non-statutory limitation(s) and explicitly recites that the computer program is embodied in a non-statutory form as cited above for claims 20-24.

Claim Rejections – 35 USC § 102

7. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

8. Claims 1,2, 10, 20-21 and 25 are rejected under 35 U.S.C. 102(b) as being

anticipated by Pub. No. US 2001/0004211 to Ookawa (Ookawa).

In Reference to Claim 1

Ookawa teaches:

A method of MR imaging comprising the steps of:

partitioning k-space into a number of partitions (see fig. 6 and section [0027] on page 2),

wherein the partitions incrementally increase in distance from a center of k-space (see fig. 6 and section [0031] on page 2); and

applying magnetic preparation pulses (flip pulse) and acquiring data such that a rate by which the magnetic preparation pulses are applied is a function of the incremental distance a partition of MR data is from the center of k-space (see fig. 5 and section [0031] on page 2).

In Reference to Claim 2

Ookawa has been shown to teach all of the limitations of claim 1. In addition Ookawa further teaches:

The method of claim 1 wherein the magnetic preparation pulses are saturation pulses (e.g. pre-saturation pulse in Ookawa; see page 2, section [0021]), and

further comprising the step of decreasing the rate by which the saturation pulses are applied as the distance a partition of MR data is from the center of k-space increases (see fig. 6 and sections [0027] – [0031] on page 2, and sections [0032] and [0033] page 3).

In Reference to Claim 10

Ookawa has been shown to teach all of the limitations of claim 1. In addition Ookawa further teaches: The method of claim 1 wherein the data acquisition in k-space includes a radial acquisition in k-space (see figs. 5 and 6, and section

NOTE: Claims 20-21 and 25 were analyzed as best understood by the examiner under the assumption that the these claims all contained proper statutory language with regard to a computer program on a computer readable storage medium (see sections relating to functional and nonfunctional descriptive material in MPEP 2106 <2106.01> and the "Interim Guidelines for Examination of Patent Applications for Patent Subject Matter Eligibility (signed 26 Oct 2005)".

In Reference to Claim 20

Ookawa teaches:

A computer program representing a set of instructions that when executed by a computer (see fig.1) causes the computer to:

partition k-space data into a number of partitions (see fig. 6 and section [0027] on page 2), each a given distance from a center of k-space (see fig. 6 and section [0031] on page 2); and play out a magnetic preparation pulse at a different rate for each partition, the rate being dependent on the given distance a partition is from the center of k-space (see fig. 5 and section [0031] on page 2) .

In Reference to Claim 21

Ookawa has been shown to teach all of the limitations of claim 21. In addition Ookawa further teaches: ... wherein the set of instructions further causes the computer

to define an elliptical centric phase ordered acquisition of k-space and wherein each partition is centered about a center of k-space (see figures 1 and 6) such that magnetic preparation occurs more frequently during MR data acquisition of a partition closer to the center of k-space than that of a partition farther from the center of k-space (see figures 1 and 5, and section [0033] on page 3).

In Reference to Claim 25

Ookawa has been shown to teach all of the limitations of claim 20. In addition Ookawa further teaches: T he computer program of claim 20 incorporated into a computer data signal that is embodied in a carrier wave that is uploadable/downloadable to an MR apparatus (see fig. 1 and sections [0019] - [0023] on page 2).

Claim Rejections - 35 USC § 103

9. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

10. Claims 3 through 6, 9 and 22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Pub. No. US 2001/0004211 A1 to Ookawa (Ookawa) in view of Pub. No. US 2005/0007110 A1 to Zhou (Zhou).

In Reference to Claim 3

The claim states: "The method of claim 1 further comprising the step of playing out at least one dummy acquisition after application of each magnetic preparation pulse."

Ookawa has been shown to teach all of the limitations of claim 1. However, Ookawa fails to teach "further comprising the step of playing out at least one dummy acquisition after application of each magnetic preparation pulse." In the applicant's disclosure the dummy pulse "while not required, may greatly improve image quality with the reduction of ghosting artifacts typically associated with steady state effects."

Zhou teaches the concept of playing out at least one dummy acquisition ("z" or zero-encoding pulse) when sampling variable regions of k-space using an elliptic centric sampling scheme as taught by the applicant (see fig. 2, section [0027] on page 3). Furthermore, Zhou teaches that the dummy acquisition is used expressly to improve the final reconstructed image by minimizing of noise producing effects and maintaining the steady state of the MR signal (see abstract and section [0027] on page 3).

It would have been obvious to one of ordinary skill in the art at the time of the invention to have included "the step of playing out at least one dummy acquisition after application of each magnetic preparation pulse" of Zhou in the method of claim1 of Ookawa in order to improve the final reconstructed image by minimizing of noise producing effects and maintaining the steady state of the MR signal as taught by Zhou.

In Reference to Claim 4

The claim states: "The method of claim 3 further comprising the step of playing out the magnetic preparation pulses every N_iTR for an ith partition, wherein $N_1<N_2<N_{M-1}<N_M$, and M corresponds to the number of partitions."

Ookawa in view of Zhou has been shown to teach all of the limitations of claim 3 as discussed above. Ookawa further teaches "the step of playing out the magnetic preparation pulses every N_iTR for an ith partition, wherein $N_1<N_2<N_{M-1}<N_M$, and M corresponds to the number of partitions" (see abstract, figs. 5 and 6, sections [0027] – [0031] on page 2, and sections [0032] – [0036] on page 3).

In Reference to Claim 5

Claim 5 states: "The method of claim 4 wherein the number of partitions includes three partitions for a given image acquisition, wherein N_i includes $N_1<N_2$ and $N_2<N_3$."

Ookawa in view of Zhou has been shown to teach all of the limitations claim 4. Ookawa further teaches that the number of (i.e. k-space) partitions (region divisions) may be "changed in various patterns" (see sections [0033] –[0036] on page 3) and "can be variously modified" to adjust the image contrast and the output of artifacts.

It would have been obvious to one of ordinary skill in the art at the time of the invention to have selected three partitions as taught to optimally vary the number of partitions in order to "adjust the image contrast and the output of artifacts" as

explicitly taught in Ookawa.

In Reference to Claim 6

Claim 6 states: "The method of claim 5 wherein the step of applying magnetic preparation pulses includes the step of playing out fat saturation pulses every five TRs for the first partition, every 15 TRs for the second partition, and every 40 TRs for the third partition."

Ookawa in view of Zhou has been shown to teach all of the limitations of claim 5. Ookawa further teaches that the rate or "frequency" at which (magnetization or) pre- pulses are played out may also be "changed in various patterns" (see sections [0034] –[0036] on page 3). Ookawa further teaches, " various patterns can be adopted for the division method of regions using different frequencies in the k-space, i.e., for region boundaries. A plurality of region division pattern data in the k-space may be prepared and may be selectively used in accordance with an instruction from the operator. These frequency patterns and region division patterns can be arbitrarily combined and used to arbitrarily adjust the image contrast and the output of artifacts." (see section [0035] on page 3)

It would have been obvious to one of ordinary skill in the art at the time of the invention to have selected the "step of playing out fat saturation pulses every five TRs for the first partition, every 15 TRs for the second partition, and every 40 TRs for the third partition" in order to "adjust the image contrast and the output of artifacts" for the particular application at hand as taught by Ookawa.

In Reference to Claim 9

Claim 9 states: "The method of claim 1 wherein the magnetic preparation pulses are fat saturation pulses, and further comprising the step of maximizing fat saturation while minimizing differential weighting of k-space while acquiring the central of region k-space."

Ookawa has been shown to teach all of the limitations of claim 1. Additionally, Ookawa has been shown to teach the step of optimizing fat saturation based on the particular application at hand (see section [0035] on page 3). However, Ookawa fails to teach "the step of maximizing fat saturation while minimizing differential weighting of k-space while acquiring the central of region k-space."

Zhou addresses the issue of compensating for "differential weighting of k-space while acquiring the central of region k-space" (see the second paragraph in sections [0006] and [0009] on page 1 and section [0009] on page 2) that results from non-steady state sampling effects when a centric phase encoding technique is used. In order to maintain steady state and minimize noise effects, peripheral-central region-based sampling delays are employed.

It would have been obvious to one of ordinary skill in the art to have included the step of "minimizing differential weighting of k-space while acquiring the central of region k-space" of Zhou in the method of Ookawa including the step of maximizing fat saturation of Ookawa in order to "maintain the MR signal steady-state and minimize distortion the MR signal is sampled for filling the center of k-space" as taught by Zhou.

In Reference to Claim 22

Claim 22 States: "The computer program of claim 20 wherein the set of instructions further causes the computer to play out a number of dummy acquisitions following each magnetic preparation pulse."

Ookawa has been shown to teach all the limitations of claim 20. In addition, Zhou has been shown to teach the concept of playing out at least one dummy acquisition (zero-encoding pulse) when sampling variable regions of k-space using an elliptic centric sampling scheme as taught by the applicant (see fig. 2, section [0027] on page 3).

It would have been obvious to one of ordinary skill in the art at the time of the invention to have included the step "wherein the set of instructions further causes the computer to play out a number of dummy acquisitions following each magnetic preparation pulse " of Zhou in the method of Ookawa in order to improve the final reconstructed image by minimizing of noise producing effects and maintaining the steady state of the MR signal as taught by Zhou.

11. Claims 7-8 are rejected under 35 U.S.C. 103(a) as being unpatentable over Pub. No. US to Ookawa (Ookawa) in view of Stephen J. Riederer (Riederer), "Current Technical Development in Magnetic Resonance Imaging", IEEE Engineering in Medicine and Biology Magazine, September/October 2000.

In Reference to Claim 7

Claim 7 states: "The method of claim 1 further comprising the step of determining

the number of partitions based on an FOV from which MR data is to be acquired."

Ookawa has been shown to teach all of the limitations of claim 1. However, Ookawa does not explicitly teach "the step of determining the number of partitions based on an FOV from which MR data is to be acquired."

Riederer addresses a number of key technical developments in MRI for the year 2000. Among these is the significance of FOV selection in k-space for determining the speed of image acquisition (i.e. smaller FOV correlates to faster image acquisition and vice versa) and spacing between k-space views or lines or strips (e.g. k-space discontinuity between adjacent views; see middle column on page 36 and figs. 1(a) – 1(c)) for fast MRI scan methods where grabbing data as quickly as possible is essential. The number of elliptic centric (radially increasing) regions chosen in k-space vary in direct proportion to the FOV.

It would have been obvious to one of ordinary skill in the art at the time of the invention to have included "the step of determining the number of partitions based on an FOV from which MR data is to be acquired" of Riederer in the method of claim1 of Ookawa in order to obtain "greater image acquisition speed."

<u>In Reference to Claim 8</u>

Ookawa in view of Riederer has been shown to teach all of the limitations of claim 7. Additionally, Riederer has also been shown to present a rationale for optimizing the spacing between consecutive k-space views according to claim 8 (see the "New Acquisition Strategies" section on pages 35 and 36 and figs. 1(a) –

1(c)).

It would have been further obvious to one of ordinary skill in the art at the time of the invention to have included "the step of determining the number of partitions to minimize k-space discontinuity between adjacent k-space views" of Riederer in the method of Ookawa in order to optimize the FOV requirements for "greater image acquisition speed" with the k-space view spacing so as to reduce artifacts and improve image quality in the reconstructed image as taught by Riederer.

12. Claims 11-16 and 18 are rejected under 35 U.S.C. 103(a) as being unpatentable over Pub. No. US 2005/0007110 to Zhou (Zhou) in view of Pub. No. US 2001/0004211 to Ookawa (Ookawa).

<u>In Reference to Claim 11</u>

Claim 11 States: An MRI apparatus comprising: resonance imaging (MRI) system having a gradient coils positioned about a bore of a impress a polarizing magnetic field and an RF transceiver system and an RF switch controlled by a pulse module to transmit RF signals to an RF coil assembly to acquire MR images; and a computer programmed to: partition k-space into a number of partitions, each having an increased distance from a center of k-space; apply magnetic preparation pulses at a first rate during data acquisition for a first radial partition; and apply magnetic preparation pulses at a second rate, different from the first rate, during data acquisition for a second partition.

Zhou teaches all of the apparatus elements of claim 11 (see fig. 1) with the

exception of the step to "apply magnetic preparation pulses at a first rate during data acquisition for a first radial partition; and apply magnetic preparation pulses at a second rate, different from the first rate, during data acquisition for a second partition."

Ookawa has been shown to teach the application of magnetic preparation pulses in k-space according to region in which you are located (see sections [0033] on page 3).

It would have been obvious to one of ordinary skill in the art at the time of the invention to have included the step of applying "magnetic preparation pulses at a first rate during data acquisition for a first radial partition; and apply magnetic preparation pulses at a second rate, different from the first rate, during data acquisition for a second partition" of Ookawa to the MRI apparatus of Zhou in order to produce an MRI system that allows for the combination of variable rate magnetization preparation pulse sampling of multiple regions in order to control image contrast and output of artifacts as taught by Ookawa.

NOTE: Claims 13 and 14 were analyzed as best understood by the examiner under the assumption that the proper citation of Claim 13 entailed a modification in the language of Claim 13 as follows: "The MRI apparatus of claim 11 *wherein the first rate is* **higher than** *the second rate* if the first radial partition is closer to the center of k-space than the second radial partition."

In Reference to Claim 13

Claim 13 States: "The MRI apparatus of claim 11 wherein the first rate is **higher**

(see NOTE) than the second rate if the first radial partition is closer to the center of k-space than the second radial partition."

Zhou in view of Ookawa has been shown to teach all of the limitations claim 11. In addition, Ookawa further teaches the step "wherein the first rate is **higher** than the second rate if the first radial partition is closer to the center of k-space than the second radial partition" (see section [0033] on page 3).

In Reference to Claim 14

Claim 14 States: "The MRI apparatus of claim 13 wherein the saturation pulse is a magnetization preparation pulse."

Zhou in view of Ookawa has been shown to teach all of the limitations claim 13. In addition, Ookawa further teaches the step "wherein the saturation pulse is a magnetization preparation pulse" (see section [0022] on page 2).

Therefore, it would have been further obvious to one of ordinary skill in the art at the time of the invention to have included the step of "wherein the saturation pulse is a magnetization preparation pulse" of Ookawa to modify the MRI apparatus of Zhou in order to obtain flexible and custom variable rate magnetization pulse sampling of multi-partitioned k-space region for a desired effect: images with high degree of fat suppression, good image contrast and minimal artifacts as taught by Ookawa.

NOTE: Claims 12 and 15-19 were analyzed as best understood by the examiner under the assumption that they were intended to depend from (apparatus) Claim 11 rather

than (method) Claim 10, and that "the apparatus" in line 1 of these Claims (12, 15-19) refers to "the MRI apparatus" in line 1 of Claim 11.

In Reference to Claim 12

Claim 12 States: "The MRI apparatus of claim 11* (where * → changed from claim 10 per preceding Note) wherein the first rate and second rate are a function of partition distance from the center of k-space."

Zhou in view of Ookawa has been shown to teach all of the limitations of claim 12 with respect to claim 11. In addition, Ookawa further teaches the step "wherein the first rate and second rate are a function of partition distance from the center of k-space" (see section [0033] on page 3).

Therefore, it would have been further obvious to one of ordinary skill in the art at the time of the invention to have included the step of "wherein the first rate and second rate are a function of partition distance from the center of k-space" of Ookawa to modify the MRI apparatus of Zhou in order to shorten the photographing (image acquisition) time and ensure a "necessary image contrast" as taught by Ookawa.

In Reference to Claim 15

Claim 15 States: "The MRI apparatus of claim 11* wherein the computer is further programmed to play out a number of dummy acquisitions after each saturation pulse."

Zhou in view of Ookawa has been shown to teach all of the limitations of claim 11. In addition, Zhou further teaches the step of applying dummy acquisitions in

order to minimize noise-producing effects and maintain steady state of the MR signal when sampling between the peripheral and central regions of k-space. Therefore, it would also have been obvious to one of ordinary skill in the art at the time of the invention to have included the step of "wherein the computer is further programmed to play out a number of dummy acquisitions after each saturation pulse" of Zhou in the saturation pulse scheme of Ookawa in order to shorten image acquisition time and improve image contrast as taught by Ookawa.

In Reference to Claim 16

Claim 16 States: "The MRI apparatus of claim 11* wherein the saturation pulses include at least one of a fat saturation pulse, an IR pulse, and a spatial saturation RF pulse."

Zhou in view of Ookawa has been shown to teach all of the limitations of claim 11. In addition, Ookawa further teaches the step of "wherein the saturation pulses include at least one of a fat saturation pulse, an IR pulse, and a spatial saturation RF pulse" (see section [0021] on page 2).

Therefore, it would also have been obvious to one of ordinary skill in the art at the time of the invention to have included the step of "wherein the saturation pulses include at least one of a fat saturation pulse, an IR pulse, and a spatial saturation RF pulse" in order to improve image contrast as taught by Ookawa.

In Reference to Claim 18

Claim 18 States: "The MRI apparatus of claim 11* wherein the computer is programmed to carry out an elliptical centric phase order acquisition of MR data from at least one of a heart region and an abdominal region of a patient."

Zhou in view of Ookawa has been shown to teach all of the limitations of claim 11. In addition, Zhou further teaches about using a computer program within an MRI system to carry out "elliptical centric phase order acquisition of MR data" from different regions or tissues within the body; particularly those which can be impacted by cancer (see section [0004] page 1).

Therefore, Zhou in view of Ookawa teaches all limitations of claim 18.

13. Claims 17 and 23 are rejected under 35 U.S.C. 103(a) as being unpatentable over Pub. No. US 2005/0007110 to Zhou (Zhou) in view of Pub. No. US 2001/0004211 to Ookawa (Ookawa) and further in view of Stephen J. Riederer (Riederer), "Current Technical Development in Magnetic Resonance Imaging", IEEE Engineering in Medicine and Biology Magazine, September/October 2000.

<u>In Reference to Claim 17</u>

Claim 17 States: "The MRI apparatus of claim 11* wherein the computer is further programmed to determine dimensions of an FOV and, from the dimensions, determine a number of radial partitions such that discontinuities between adjacent k-space locations are reduced."

Zhou in view of Ookawa has been shown to teach all of the limitations of claim

However, Zhou in view of Ookawa fails to explicitly teach the step "wherein the

computer is further programmed to determine dimensions of an FOV and, from the dimensions, determine a number of radial partitions such that discontinuities between adjacent k-space locations are reduced." Riederer teaches utilizing fast scan/imaging techniques that employ FOV calculation and compensation methods, which in turn have a direct bearing on k-space discontinuities (see figs. 1a – 1c) and middle paragraph on page 36.

Therefore, it would also have been obvious to one of ordinary skill in the art at the time of the invention to have included the step "wherein the computer is further programmed to determine dimensions of an FOV and, from the dimensions, determine a number of radial partitions such that discontinuities between adjacent k-space locations are reduced" of Riederer in the elliptic centric phase order acquisition MR apparatus/system of Zhou in view of Ookawa in order to determine the spacing between k-space views (radial partitions) required for each k-space acquisition as taught by Riederer.

14. Claim 19, is rejected under 35 U.S.C. 103(a) as being unpatentable over Pub. No. US 2005/0007110 to Zhou (Zhou) in view of Pub. No. US 2001/0004211 to Ookawa (Ookawa) and further in view of US Pat. No. 6,380740 to Laub (Laub).

<u>In Reference to Claim 19</u>

Claim 19 States: "The MRI apparatus of claim 11* wherein the computer is programmed to partition k-space into partitions of similar size."

Zhou in view of Ookawa has been shown to teach all of the limitations of claim 18 with respect to claim 11. However, Zhou in view of Ookawa fails to explicitly teach the step "wherein the computer is programmed to partition k-space into partitions of similar size." Laub teaches the partitioning of k-space into partitions of similar size (see Laub column 7, lines 7-26). Laub further teaches that the selection of the number and relative size of the segments may be varied and customized to the application at hand so as to enable sufficient spatial and temporal resolution for tracking dynamic (fast) events within the body (see Laub, column 7, lines 13-21).

Therefore, it would also have been obvious to one of ordinary skill in the art at the time of the invention to have included the step "wherein the computer is programmed to partition k-space into partitions of similar size" of Laub in the magnetization preparation scheme and MRI system of Zhou in view of Ookawa in order to be able to obtain adequate and rapid spatial and temporal resolution for acquiring images using a rapid scanning technique.

15. Claims 23 and 24 are rejected under 35 U.S.C. 103(a) as being unpatentable over Pub. No. US 2001/0004211 to Ookawa (Ookawa) in view of Pub. No. US 2005/0007110 to Zhou (Zhou) and further in view of US Pat. No. 6,380740 to Laub (Laub).

In Reference to Claim 23

Claim 23 States: " The computer program of claim 22 wherein the set of instructions further causes the computer to define boundaries of each partition and determine the number of partitions based on a k-space extent of a 3D image FOV."

Ookawa in view of Zhou has been shown to teach all of the limitations of claim claim 22. However, Ookawa in view of Zhou fails to explicitly teach the step "wherein the set of instructions further causes the computer to define boundaries of each partition and determine the number of partitions based on a k-space extent of a 3D image FOV." Laub teaches the partitioning of k-space into 3D annular partitions so as improve spatial and or time resolution (see Laub figures 3,4 and 6, and column 3, lines 23-63). Laub further teaches that the selection of the number and relative size of the segments may be varied and customized to the application at hand so as to enable sufficient spatial and temporal resolution for tracking dynamic (fast) events within the body (see Laub, column 7, lines 13-21).

Therefore, it would also have been obvious to one of ordinary skill in the art at the time of the invention to have included the step "wherein the set of instructions further causes the computer to define boundaries of each partition and determine the number of partitions based on a k-space extent of a 3D image FOV" of Laub in the computer program of Ookawa in view of Zhou in order to obtain a higher time/spatial resolution for acquiring 3D image data sets as taught by Laub.

In Reference to Claim 24

Claim 24 States: " The computer program of claim 23 wherein the set of instructions further causes the computer to define the boundaries and the number of partitions such that k-space discontinuity between adjacent k-space views is reduced."

Ookawa in view of Zhou further in view of Laub has been shown to teach all of the limitations of claim claim 23. Laub further teaches that the 3D annular segments of his invention are bounded consecutively (respectively or one after the other) so as that a central region is encompassed within a number of peripheral regions and that this approach improves spatial resolution over prior methods (see Laub figures 3,4 and 6, column 3, lines 28-63, column 7, lines 38-46). Also, the MR data is acquired using centric phase encoding. It is well known in the art that centric phase encode methods such as described by Laub employ techniques which minimize k-space discontinuities between adjacent k-space views.

Therefore, it would also have been obvious to one of ordinary skill in the art at the time of the invention to have included the step "wherein the set of instructions further causes the computer to define the boundaries and the number of partitions such that k-space discontinuity between adjacent k-space views is reduced" of Laub in the computer program of Ookawa in view of Zhou in order to improve time/spatial resolution for acquiring 3D image data sets as taught by Laub.

Conclusion

16. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Ookawa et al., Ahluwalia et. al., Mulger et. al., and Hargreaves et al. have been included because they all teach applying custom pre-pulse and flip pulse schemes in combination in order to obtain high contrast and fast scan MR images; usually involving (MR) species specific (fat, water, etc.) suppression prior to species of interest acquisition. Additionally, Watts et al., Riederer et al., Wiebel et al. have been included because they all teach fast scan MRA techniques employing elliptic centric phase ordered acquisitions and the significance of radial region definitions and sampling (acquisition). Moreover, Riederer and Watts also describe the importance of FOV determination and compensation in order to speed up and tailor scan time for rapid image acquisition.

17. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Salieu M. Abraham whose telephone number is (571) 270-1990. The examiner can normally be reached on Monday through Thursday 8:30 am - 6:00 pm EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Kenneth Bomberg can be reached on (571) 272-4922. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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